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Maximizing the lift-drag ratio of wing airfoils with a turbulent boundary layer: Exact solutions and approximations

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Abstract

Exact solutions and approximations for maximizing the lift-drag ratio of wing airfoils with a turbulent boundary layer is discussed. The employment of the inviscid incompressible-fluid and boundary-layer models enables to write the optimized functional and the optimization constraints in the explicit form. The need of the smooth and separationless flow is a necessary assumption in the formulation of the problem. The consideration of the fact that the calculation of the whole layer as fully turbulent yields more reliable values of the airfoil loss coefficients, with the consideration of the fully turbulent flow around the airfoil. The wing airfoil shape is also numerically optimized to obtain the global maximum of the lift-drag ratio under the conditions of the absence of turbulent boundary layer-separation and the airfoil contour simplicity.

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